Ontario Geological Survey

Northern Ontario
Engineering Geology Terrain Study 64

ELSAS AREA

(NTS 42B/NE)

Districts of Algoma and Cochrane

by

Hulbert A. Lee and S.A. Scott

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MAP
(accompanying report)

Map 5100 (coloured) – Northern Ontario Engineering Geology Terrain Study, Data Base Map, Elsas (NTS 42B/NE). Scale 1:100 000.

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Hulbert A. Lee[1] and S.A. Scott[2]

1.0 INTRODUCTION

This report accompanies a Data Base Map (OGS Map 5100) which characterizes the terrain in the Elsas map-area, Districts of Algoma and Cochrane by means of letter symbols that relate directly to reconnaissance engineering conditions. The area, which covers NTS block 42B/NE, lies between Latitudes 48°30'N and 49°00'N and Longitudes 82°00'W and 83°00'W. The report is one of a series which provides uniform terrain data for approximately 370 000 km^2 of northern Ontario.

The purpose of the mapping is to provide complete data coverage which can then be utilized for engineering and resource planning. The explanatory notes in this report are intended to expand on characteristics of the terrain units that are specific to the Elsas map-area, and to describe the

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engineering significance of the units.

The primary method of mapping was airphoto interpretation, using existing black and white photographs at a scale of approximately 1:50 000. Prior to interpretation, both a literature search and ground reconnaissance were carried out. Preliminary data thus obtained, including geology, outcrop distribution, and relief, were plotted on a copy of the base map. A quick overview of the map-area was gained from both colour and black-and-white satellite imagery. Ground reconnaissance consisted of travelling through all accessible areas by road and rail, making terrain observations, sampling soil materials, and taking photographs. Thus the map represents a reconnaissance level presentation of engineering conditions.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. The letter symbols function as a shorthand, describing surface materials, genetic landforms, topography, and drainage. Further information on the mapping techniques, legend format, and possible uses of the terrain data is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed 1980), a companion publication to this series of maps and reports.

2.0 GEOLOGICAL SETTING

The northern part of the Elsas map-area encompasses a lowland, while the southern part is dominated by a rough-surfaced upland. Elevations (above mean sea level) range from 245 m in the north to 400 m in the south. Drainage of the area is to the north by the Kapuskasing, Wakusimi, Ivanhoe, and Groundhog Rivers.

2.1 BEDROCK

All bedrock underlying the Elsas map-area is of Early Precambrian (Archean) age, with the exception of a Late Precambrian mafic to intermediate intrusive complex in the north-central part of the area. For engineering purposes, they can be considered as solid and firm. The rocks have been mapped on a reconnaissance basis (Thurston, Siragusa,

and Sage 1971, 1977), with parts of the area having been studied in more detail by Bennett (1966a, b, c, d, 1969) and McMurchy (1960).

The topography of the map-area in large part reflects the resistance to erosion of the underlying bedrock types. The granulites of the Kapuskasing gravity high trend northeastward across the central portion of the map-area and form the medium- and high-relief steeply sloping bedrock hills in Lougheed, Ossin, Wadsworth, Lisgar, and Watson Townships. Hybrid rocks and felsic intrusives lie to the northwest of the granulites. Relief on these rocks is generally low, except in Amundsen and Davin Townships where it is medium. Metamorphosed and partly digested volcanic, sedimentary, and mafic to ultramafic intrusive rocks lie to the southeast of the granulites. Relief on these rocks is low to medium.

The photo interpretation carried out during this study revealed more bedrock-controlled hills, probably with more outcrop, than is indicated on the reconnaissance bedrock geology maps (Thurston, Siragusa, and Sage 1971, 1977).

2.2 SURFICIAL

Data on surficial geology is contained on a reconnaissance map compiled by Boissoneau (1965), but to date there has been no systematic detailed study of the map-area.

The Wisconsinan ice margin retreated northward across the map-area, as indicated by the general trend of glaciofluvial deposits, mainly the esker complexes. Against and in close proximity to this retreating ice was Glacial Lake Barlow-Ojibway, which was dammed on the north by the ice sheet and on the south by high ground. The extensive glaciolacustrine deposits (lake plain banded silt and sand, and lake beach sand) in the Elsas map-area belong to this phase, as do the bedrock areas which are shown to have a capping of washed till. Wave action at a series of old shoreline elevations has sorted or removed some of the finer fractions of the till. Some of the high hills, such as those in Wadsworth Township, rose above the level of the glacial lake; the till lying on these hills has its original composition.

A southeasterly readvance of the ice (Cochrane I readvance) into the northern two-thirds of the map-area deposited clayey silt till on top of the glaciolacustrine and glaciofluvial deposits.

When the ice front finally withdrew from the area, the glacial lake disappeared completely, and extensive bog deposits developed in depressions and flats.

3.0 DESCRIPTION OF ENGINEERING TERRAIN UNITS

The terrain units described below are arranged by landform in descending order of areal importance within the Elsas map-area. A representative selection of terrain unit letter codes is given for each landform, each with accompanying explanation. This treatment is meant to familiarize the reader with the meaning of the legend symbols and allow more effective use of the Data Base Map (OGS Map 5100, accompanying this report). A discussion of the engineering significance of the various terrain units is given in Section 5.0.

3.1 ORGANIC

$\frac{\text{pOT}}{\text{Lp-W}}$

Organic terrain (OT), composed of sphagnum peat, dead wood, and sedges (p), occurs as confined bogs throughout the map-area. This unit is reserved chiefly for areas barren or semi-barren of trees, and where parts of the bog are likely deep. The large area of organic terrain in Hicks Township is an example of this terrain condition. The local relief is low (L), and the surface is planar (p) and wet (W).

$\frac{\text{pOT(cmLP)}}{\text{Lp-W(M)}}$

Organic terrain (OT) composed of peat (p), with a nearly equal amount of silt and clay lake plain (cmLP), occurs in Poulett and Belford Townships. Local relief is low (L) and the land surface is planar (p); drainage is wet (W) on the organic terrain and mixed (M) on the lake plain.

pOT/cmLP
Lu-W

Organic terrain (OT) composed of peat (p) forms a continuous but thin cover over lake plain clay and silt (cmLP) in south-eastern Buchan Township. Relief is low (L) and the surface is undulating (u) and wet (W).

pOT/cmLP(RP)
Lp-Dh

Organic terrain (OT) composed of peat (p) forms a thin cover over lake plain clay and silt (cmLP); there are a few scattered low bedrock outcrops (RP). An example of this unit occurs in western Buchan Township. Local relief is low (L), the land surface is planar (p), and the water table is within 1 m of the surface (Dh).

pOT(mLP) (RN)
Lp-Dh

Organic terrain composed of peat (pOT), with large areas of lake plain silt (mLP) and a few rock knobs (RN), occurs in Kapuskasing Township.

3.2 BEDROCK

RN(tcMG)
Msw-D

RN(tcMG)
Hsw-D

Rock knobs (RN), with some ground moraine clayey silt till (tcMG) between the outcrops characterize the bedrock terrain in northern Ossin Township and central Wadsworth Township. Local relief is either medium (M) or high (H). The land surface has steep slopes (s), the till is washed (w), and surface drainage conditions are dry (D).

RN(tMG)
Hnj-D

RN(tMG)
Mnj-D

Rock knobs (RN), with some ground moraine till (tMG) between the outcrops, characterize the bedrock terrain of central Lougheed Township. Local relief is generally greater than 60 m (H) and occasionally 15 to 60 m (M). The land surface is knobby (n), rough and jagged (j), and dry (D).

RP(tcMG) / Lu-D

Rock plain (RP), composed of low outcrops and thin drift, with local thickening of the ground moraine, clayey silt till (tcMG), characterizes the bedrock terrain of southern Oscar Township. Local relief is less than 15 m (L) and the land surface is undulating (u) and dry (D).

tcMG/RN / Mj-D tcMG/RN / Hsw-D

Rock knobs (RN) are the dominant engineering factor in this unit, which has a thin but fairly continuous cover of ground moraine clayey silt till (tcMG). This type of terrain is found in western Wadsworth Township. Local relief is mainly 15 to 60 m (M) or occasionally greater than 60 m (H). The land surface is rough and jagged (j), or has steep slopes (s) on which the ground moraine till has been washed and partly reworked (w).

tMG/RN (pOT) / Luw-M

tMG/RN(pOT) / Muw-M

Rock knobs (RN) are the dominant engineering factor in this unit, which has a fairly continuous cover of ground moraine till (tMG). This terrain type is found in the western portions of Amundsen and Kapuskasing Townships. Local relief is low (L) to moderate (M), the land surface is undulating (u), and surface drainage is mixed (M). The ground moraine till is washed and reworked (w).

RR / Mjr-D

Rock ridges (RR), consisting of elongated bedrock hills, occur in a narrow band in Seaton Township. Local relief is moderate (M). The land surface consists of multiple ridges (r) and is rough and jagged (j). Drainage conditions are dry (D).

3.3 GLACIOLACUSTRINE

smLP / Ldp-D sLB / Lpt-D sLB / Lp-D

Lake plain (LP) consisting of fine sand and silt (sm) and lake beach sand (sLB), characterize the glaciolacustrine terrain in Clouston Township. Local relief is low (L). The land surface is planar (p), and locally is either dissected by narrow deep gullies (d), or terraced (t). Surface drainage conditions are dry (D).

smLP(pOT) / Lp-Dh smLP / Lp-Dh

Lake plain (LP), composed mainly of fine sand and silt (sm) characterizes the glaciolacustrine terrain in Seaton and Watson Townships. There are a few scattered bogs (pOT) in depressions. Local relief is low (L), the surface is planar (p), and the water table is within 1 m of the surface (Dh).

mcLP(sLB) (pOT) / Mu-D

Lake plain (LP) composed of silt and clay (mc), interspersed with raised lake beaches of sand (sLB), and scattered bogs in the depressions (pOT), characterizes the glaciolacustrine terrain in northwestern Belford Township.

cmLP / Lp-M sLP / Lp-D

cmLP(sLP) / Lp-M

Lake plain (LP), composed of either clay and silt (cm) or fine sand (s), characterizes the glaciolacustrine terrain in Montcalm and Strachan Townships. Local relief is low (L), the land surface is planar (p) and drainage conditions are either dry (D) or mixed (M).

3.4 MORAINAL

tcMG(pOT) (RP) / Lu-D(W) (D)

Ground moraine composed of clayey silt till (tcMG), with numerous patches of bog (pOT) and a few scattered low outcrops (RP), characterizes the morainal terrain in

the northwestern portion of the map-area. Local relief is low (L) and the land surface is undulating (u). Drainage conditions are dry (D) on the ground moraine and rock plain and wet (W) in the organic terrain.

tcMG(pOT) / Lu-D(W)

Ground moraine composed of clayey silt till (tcMG), with numerous interspersed patches of bog (pOT), characterizes the morainal terrain in Davin Township. Local relief is low (L) and the land surface is undulating (u). Drainage conditions are dry (D) in the ground moraine and wet (W) in the organic terrain.

tcMG(RN) / Mwsn-D

Ground moraine composed of clayey silt till (tcMG), with interspersed rock knobs (RN), characterizes the morainal terrain in Amundsen and Kapuskasing Townships. Local relief is generally 15 to 60 m (M). The land surface has steep slopes (s) and is knobby (n), and the till has been reworked and washed (w). Surface drainage conditions are dry (D).

3.5 GLACIOFLUVIAL

tcMG/sgGE / Mnk-D tcMG/sgGE / Mr-D

The esker complexes (GE) found in Lisgar and Wadsworth Townships composed of sand and gravel (sg) and have a capping of 1 to 3 m of clayey silt till (tcMG). Local relief is 15 to 60 m (M), and the land surface is hummocky (n) and kettled (k), or ridged (r). Surface drainage conditions are dry (D).

smLP/sgGE / Lpk-D smLP/gsGE / Mpk-D

The esker complexes (GE) found in Fenton and Seaton Townships are composed of sand and gravel (sg) or gravel and sand (gs)

and have a capping of 1 to 3 m of lake plain sand and silt (smLP). Local relief is low (L) or moderate (M), the land surface is planar (p) and kettled (k), and surface drainage conditions are dry (D).

sgGE / Mp-D sgGE / Lp-D

The esker complex in Strachan Township is composed of sand and gravel (sgGE) and has local moderate (M) or low (L) relief. The land surface is planar (p) and surface drainage conditions are dry (D).

smGD / Ldt-M smGD / Ldc-M

The glaciofluvial delta in Amundsen Township is composed of fine sand and silt (smGD) and has local low relief. The land surface is dissected (d) and locally terraced (t) or channelled (c). Surface drainage conditions are mixed (M).

3.6 ALLUVIAL

smAP / Lpd-D smAP(sGO) / Lp-D

Alluvial plain deposits (AP), consisting of sand and silt (sm), are shown only along larger streams where they are of adequate areal extent for mapping. Most of the streams in the map-area have narrow alluvial plains, many relating to spring floods, but these are not shown. The only sizeable example of this unit occurs along the Groundhog River in the northeastern part of the map-area. Along the northern portion of the river, glaciofluvial outwash sand (sGO), occurs with the alluvial plain deposits. Local relief is low (L) and the land surface is planar (p) and, in places, dissected (d). Surface drainage conditions are dry (D).

4.0 OBSERVATION NOTES

The following brief notes refer to sites in the Elsas map-area at which ground observations were made. The corresponding numbered locations can be found on the Data Base Map. A note such as (ov: 15 m) means that there is a 15 m thickness of soil overlying bedrock. Reference to source data is made where appropriate; all unreferenced data was obtained during this study.

Observation Site	Description
1	Ov: 46 m sand (determined from 1 borehole) (McMurchy 1960)
2	4 to 5 m of sand and gravel exposed; covered by boulders at surface (McMurchy 1960)
3	Ground moraine clayey silt till over rock plain, with minor outcrops; terrain is low, rolling, and dry
4	Ground (end?) moraine clayey bouldery till; terrain is low, rolling, and dry
5	Crushable gravel in esker; terrain has moderate relief, and is ridged and dry
6	Lake plain banded silt; terrain has low relief and is deeply dissected and dry; hand penetrometer shows resistance of 690 kPa (100 psi) at a depth of 3 m
7	Esker complex of sandy crushable gravel, terrain has moderate relief and is ridged and dry
8	Ov: 2 m (determined from 1 borehole); 'clay' over 'granite' (Ontario Water Resources Commission 1972)
9	Ov: 12 m (determined from 1 borehole); bedrock is 'granite'; static water level is above surface (i.e. the well is flowing) (Ontario Water Resources Commission 1972)

10 Ov: 2 m (determined from 1 borehole); bedrock is 'granite' (Ontario Water Resources Commission 1972)

11 0.5 m of clayey silt till overlies 4 m of gravel in an esker pit face

12 2 m of clayey silt till overlies glaciolacustrine varved silt

5.0 ENGINEERING AND RESOURCE SIGNIFICANCE

Potential resources of the Elsas map-area are minerals, forestry, and sand and gravel aggregate.

The Abitibi Volcanic Belt, famous for mineral deposits in Ontario and Quebec, passes through this map-area. The rocks have been metamorphosed adjacent to the Kapuskasing gravity high, a factor which has made mineral exploration difficult. There are numerous occurrences of copper-zinc sulphides in Nova, Belford, Montcalm, Watson, Seaton, and Hicks Townships. Ultramafic rocks occurring in Watson and Belford Townships have possible copper and nickel associations. A copper-nickel deposit in Montcalm Township has been outlined by drilling, but has not been put into production (Northern Miner Press 1979, p. 272).

Areas suitable for forest management are scattered, the most continuous ones being (a) on clayey silt till in Maude, Concobar, and Allenby Townships in the northwestern part of the area; (b) on fine sand, silt, and clay in Seaton, Lisgar, and Watson Townships in the north-central part; and (c) on other glaciolacustrine units in and around Strachan Township in the southeastern part of the area.

Sand and gravel resources are moderately extensive in the esker complexes of Lisgar and Wadsworth Townships, and also in Nova Township.

5.1 ORGANIC TERRAIN

Drainage, flooding, and settlement problems associated with the organic terrain units make them generally unsuitable for roads and foundations. Because construction materials are not available locally, engineering project costs are higher. The organic terrain units include the following

varieties: (a) bog only, in which construction conditions are unsuitable; (b) bog and another unit in almost equal proportions, in which scattered parts of the unit are satisfactory for habitation; and (c) a thin layer of organic material overlying another unit, in which road construction costs will be less in areas consisting exclusively of bog, although considerable testing is required.

5.2 BEDROCK TERRAIN

Approximately one-third of the Elsas map-area has bedrock within 2 metres of the surface, a factor which affects most types of construction. Along the northern margin of the area, the rock plain units have local relief of less than 15 metres and do not cause significant road alignment problems. There is usually sufficient borrow materal available locally from the intermixed areas of clayey silty soils to provide the bottom sub-base for roads. However, subsurface installations will generally require some blasting of the bedrock.

Most of the bedrock terrain is of medium and high relief, with steep slopes and rugged, jagged surfaces. These areas will present the following difficulties for engineering and resource management:

1. blasting required for most types of below-ground excavations;
2. lack of sand and gravel construction materials;
3. site-regrading due to steep slopes;
4. cut-and-fill operations, requiring blasting of bedrock for major transportation routes or the acceptance of considerable vertical and horizontal alignments;
5. lack of good and reliable sources of ground water, unless aquifer fractures are intersected in drilling;
6. difficult environments for disposal of solid and toxic wastes.

5.3 GLACIOLACUSTRINE TERRAIN

Most of the Elsas map-area is a lowland surface composed mainly of fine sand and silt or varved silt and clay, in a few places interspersed with rock knobs and shallow bogs. The lake plain areas are flat and have mixed drainage. The lake beach sand of this terrain are low, flat, raised ridges and are dry. The soils have adequate bearing strength for small structures and are moderately easy to excavate and handle, although the

silt has a tendency to wash into excavations and to form gullies on slopes. The finer soils react unfavourably to frost conditions, a factor which must be taken into account in the design of footings, small slabs, and roadways. Habitation construction on these fine-grained soils is generally good, except for those areas that are dry with a high water table.

5.4 MORAINAL TERRAIN

The ground moraine till in the northwestern part of the Elsas map-area has a major silt component, a lesser but still important clay component, and a low content of sand. Lee and Scott (1980) found the composition of this till at a site in the adjoining map-area to the north to be clay 28%, silt 57%, and sand 15%. The water content was 16%, plastic limit was 17%; and liquid limit was 30%. Total carbonate was high at 39%. These soils retain some moisture, which tends to make handling difficult, especially when they are wet. They have adequate bearing strength for small structures, but are highly susceptible to frost action, a factor which should be considered in the design of roads and shallow slab foundations. Installation of septic tanks will encounter no major problems, but suitable granular material will need to be imported for tile beds. The local relief is generally low, the surface undulating, and surface drainage mixed. Trafficability is fair over this terrain in dry weather, but poor under wet conditions.

The ground moraine till in the southwestern part of the map-area is interspersed with numerous rock knobs, and relief is moderate with local steep slopes. The engineering conditions are transitional between the morainal terrain to the north and bedrock terrain to the south.

5.5 GLACIOFLUVIAL TERRAIN

The relief and water table conditions for this group of landforms are variable. Many of the esker complexes have moderate local relief, thus necessitating cut-and-fill operations to overcome the problems of gradients on steep slopes. Horizontal route alignments will be necessary around numerous small lakes. In the glaciofluvial deltaic areas of low relief, alignment problems are not present and trafficability is good.

Some of the esker glaciofluvial terrain is buried below clayey silty soils of till and lake plain derivation; hence, construction procedures on such a

surface are similar to those used on fine-grained soils of the morainal and glaciolacustrine units.

Where septic tanks or solid or liquid waste disposal sites are established on thin cover overlying permeable glaciofluvial materials, problems of water pollution may be encountered.

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